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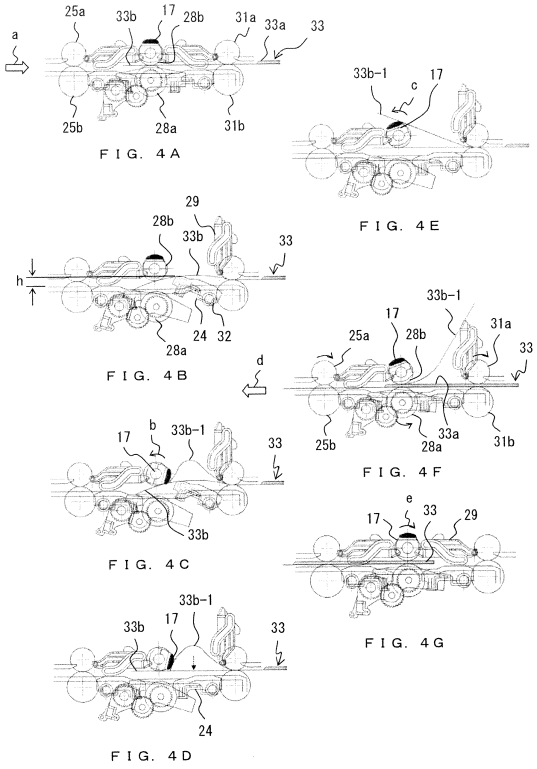
(54) **Booklet printing apparatus with page flipping mechanism**

(57) The present invention intends to provide a page flipping mechanism that reduces an occurrence of a flipping of multiple pages at once at the time of page flipping. The configuration includes that (a) a booklet (33) is inserted, (b) when a following page (33b) of facing pages reaches a position of a flipping roller (17), feeding is stopped, and a gripper of a feeding roller pair (28a) and (28b) opens, a movable guide (29) releases an upper restriction, a lifting member (24) lifts the following pages (33b) up to a 60% height, the flipping roller (17) rotates 260 degrees at a 40% speed while vibrating and bends the top page (33b-1) upwards, (d) the flipping roller (17) is stopped, the lifting member (24) descends, the flowing pages (33b) returns to a horizontal position, an end edge of the top page (33b-1) is pressed on the flipping roller (17), (e) the flipping roller (17) rotates 120 degrees, flips up the top page (33b-1) and stops, and the top page (33b-1) flops over the flipping roller (17), (f) the feeding roller pair (28a) and (28b) closes the gripper, all feeding roller pairs rotates in a booklet ejection direction, the top page (33b-1) is lifted by a driven roller (28b) of the feeding roller pair, is pushed down, and overlays the preceding page (33a), (g) the booklet (33) is ejected outside and each of the members return to home positions (See page FIG. 4).

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## Description

### BACKGROUND OF THE INVENTION

### FIELD OF THE INVENTION

**[0001]** The present invention relates to a booklet printing apparatus and more specifically to a booklet printing apparatus provided with a page flipping mechanism that reduces as much as possible an occurrence of a flipping of multiple pages at once at the time of page flipping of a booklet of multiple pages without changing a conventional simple structure.

### DESCRIPTION OF THE RELATED ART

**[0002]** Conventionally, ATMs (Automated Teller Machines) placed in banks, for example, are provided with page flipping mechanism inside to flip pages when the content needing to be printed exceeds the last print line of two facing pages of a booklet of multiple pages, such as a bank passbook.

**[0003]** In general, a page flipping mechanism that mechanically and automatically flips pages of a booklet is provided with feeding rollers coaxially having flipping rollers at the center portion. When a booklet is carried into a page flipping position, all feeding rollers are stopped and page flipping is performed by rotating only the flipping roller.

**[0004]** However, this page flipping mechanism may cause a problem of flipping subsequent pages at the same time a single page is to be flipped, which is so-called multiple page flipping.

**[0005]** In order to prevent this problem, for example, in Japanese Laid-Open Patent Publication No. H06-155964, a turning-over mechanism has been proposed in which turning-over rollers are rotated while vibrations are given by piezoelectric bimorphs and two dedicated sensors check a completion of page flipping.

**[0006]** However, the turning-over mechanism in Japanese Laid-Open Patent Publication No. H06-155964 has a problem wherein there is a significant increase in the cost because the turning-over mechanism requires plural costly members such as piezoelectric bimorphs and two dedicated sensors, and also requires a control circuit to drive these members at the right time, and the entire assembly thereby becomes complex.

### SUMMARY OF THE INVENTION

**[0007]** It is desirable to provide a booklet printing apparatus provided with a page flipping mechanism that reduces as much as possible the occurrence of the flipping of multiple pages at once at the time of page flipping of a booklet of multiple pages without changing a conventional simple structure.

**[0008]** For example, in a booklet printing apparatus provided with a page flipping mechanism of the present invention, the page flipping mechanism includes at least an insertion/ejection feeding roller, an intermediate feeding roller, an inner feeding roller, a page flipping roller arranged coaxially with the intermediate feeding roller and rotated by a dedicated motor independently from the intermediate feeding roller, and a lifting member arranged below a surface of a feeding route between the intermediate feeding roller and the inner feeding roller.

**[0009]** A booklet is inserted by the insertion/ejection feeding roller with a first line of printing field on facing pages in front, is fed by the intermediate feeding roller taking over feeding, and is pulled inside by feeding of the inner feeding roller.

**[0010]** With respect to this booklet, the lifting member lifts a portion in which a page to be flipped of the facing pages of the booklet is present up to 60% to 100% height of a normal lifting height from a bottom, the dedicated motor rotates at a low speed to rotate the page flipping roller at a 60% speed of a normal rotation and generate cogging, and the page flipping roller flips the page to be flipped by 20% to 60 % rotation of the normal rotation while propagating vibration of cogging of the dedicated motor to the page to be flipped.

**[0011]** As a result, the booklet printing apparatus is provided with a page flipping mechanism that reduces as much as possible the occurrence of the flipping of multiple pages at once at the time of page flipping of a booklet of multiple pages without changing a conventional simple structure.

### BRIEF DESCRIPTION OF DRAWINGS

**[0012]** Features of invention embodiments will now be described, with reference to the accompanying drawings, in which:

FIG. 1 is a functional block diagram illustrating the entirety of a structure of a booklet printing apparatus provided with a page flipping mechanism according to Embodiment 1;
FIG. 2A is a perspective view illustrating only a main portion of a page flipping mechanism provided according to embodiment 1 with some portions cut out;
FIG. 2B is a plan view of FIG. 2A;
FIG. 3 is a side view that schematically and comprehensively illustrates the structure of the main portion of the page flipping mechanism according to embodiment 1;
FIG. 4A is operating state diagram (1) sequentially illustrating the operations of page flipping in the page flipping mechanism according to embodiment 1;
FIG. 4B is operating state diagram (2) sequentially illustrating the operations of page flipping in the page flipping mechanism according to embodiment 1;
FIG. 4C is operating state diagram (3) sequentially illustrating the operations of page flipping in the page flipping mechanism according to embodiment 1;
FIG. 4D is operating state diagram (4) sequentially

illustrating the operations of page flipping in the page flipping mechanism according to embodiment 1;
FIG. 4E is operating state diagram (5) sequentially illustrating the operations of page flipping in the page flipping mechanism according to embodiment 1;
FIG. 4F is operating state diagram (6) sequentially illustrating the operations of page flipping in the page flipping mechanism according to embodiment 1;
FIG. 4G is operating state diagram (7) sequentially illustrating the operations of page flipping in the page flipping mechanism according to embodiment 1;
FIG. 5A is a table that lists data of actual measurements of the success rate of flipping and the prevention rate of flipping of multiple pages at once among the occurrences of successful flipping when the rotation speed of flipping is a normal speed and the lifting height is changed to various heights;
FIG. 5B is a graph of the data of the three columns next to the lifting height column in the table of FIG. 5A;
FIG. 5C is a graph of the data of the right three columns in the table of FIG. 5A;
FIG. 6A is a graph combining the two graphs in FIG. 5B and FIG. 5C into one;
FIG. 6B is a graph of when the two pieces of graph data in FIG. 5B and FIG. 5C are synthesized (integrated), representing a comprehensive success rate of flipping when the two measurements are performed;
FIG. 7A is a table that lists data of actual measurements of the success rate of flipping and the prevention rate of flipping of multiple pages at once among the occurrences of successful flipping when the lifting height is the conventional height and the motor rotation speed is changed to various speeds;
FIG. 7B is a graph of the data of the three columns next to the motor rotation speed column in the table of FIG. 7A;
FIG. 7C is a graph of the data of the right three columns in the table of FIG. 7A;
FIG. 8A is a graph combining the two graphs in FIG. 7B and FIG. 7C into one; and
FIG. 8B is a graph of when the two pieces of graph data in FIG. 7B and FIG. 7C are synthesized (integrated), representing a comprehensive success rate of flipping when the two measurements are performed.

## DESCRIPTION OF THE EMBODIMENTS

**[0013]** FIG. 1 is a functional block diagram illustrating the entirety of a structure of a booklet printing apparatus provided with a page flipping mechanism according to Embodiment 1. As illustrate in FIG. 1, in a booklet printing device 1 provided with a page flipping mechanism in this embodiment, a CPU (Central Processing Unit) 2 that controls the entirety of the booklet printing apparatus takes a central role.

**[0014]** The CPU 2 is connected to a ROM (Read Only Memory) 4, a RAM (Random Access Memory) 5, an image sensor control circuit 6, a print head drive circuit 7, a sensor control circuit 8, a flipping roller motor drive circuit 9, a feeding roller motor drive circuit 10, a print carrier motor drive circuit 11, and a lifting roller drive circuit 12 via a bus 3.

**[0015]** The image sensor control circuit 6 is connected to an image sensor 13. The image sensor 13 is a sensor to read a position mark etc. in a printing area of a booklet and to discriminate it as an image. The print head drive circuit 7 is connected to a print head 14. The print head 14 is for printing a date, an amount, and remarks etc. in print lines of a printing area of a booklet.

**[0016]** The sensor control circuit 8 is connected to various sensors 15. Here, various sensors are indicated by a single number 15 for the sake of expedience, but the sensors, such as a booklet insertion detection sensor, a booklet page flipping position detection sensor, and a booklet ejection detection sensor, are each arranged at respective important positions.

**[0017]** The flipping roller motor drive circuit 9 is connected to a flipping roller motor 16, and the flipping roller motor 16 is coupled with a flipping roller 17. The flipping roller 16 rotates at a speed so low that cogging occurs as described later in more detail, and drives the flipping roller 17 to rotate.

**[0018]** The feeding roller motor drive circuit 10 is connected to a feeding roller motor 18 and the feeding roller motor 18 is coupled with plural feeding rollers 19 via a pulley, a belt, a gear train, a clutch, etc., not illustrated in the drawings. In this description, the feeding rollers 19 are indicated by a single number 19 for the sake of expedience, but an independent number is assigned to each of the feeding rollers 19 in the subsequent drawings.

**[0019]** Each feeding roller 19 is configured of a roller pair of a driving roller and a driven roller. The feeding roller motor 18 drives the respective driving rollers of plural feeding roller pairs to rotate at the drive timing.

**[0020]** The print carrier motor drive circuit 11 is connected to a print carrier motor 21, and the print carrier motor 21 is coupled to a print carrier 22 that mounts and holds the print head 14 in a freely attachable/detachable manner. The print carrier motor 21 linearly drives the print carrier 22 in a printing direction at the timing of printing.

**[0021]** The lifting roller drive circuit 12 has a lifting roller motor 23 connected to it. The lifting roller motor 23 is coupled to a lifting member 24. Although more details are described later, the lifting roller motor 23 drives the lifting member 24 by lifting the lifting member 24 up to a height that is lower than the height at which a page to be flipped is lifted from the bottom in conventional page flipping mechanisms (hereinafter simply referred to as a conventional height or a conventional lifting height).

**[0022]** FIG. 2A is a perspective view illustrating only a main portion of a page flipping mechanism provided in the booklet printing device 1 according to the present embodiment, with some portions cut out from the illustration, and FIG. 2B is a plan view of FIG. 2A. Since this

main portion is schematically illustrated in the subsequent drawings in a comprehensible manner, the main portion is briefly explained here.

**[0023]** FIG. 2A and FIG. 2B illustrate a feeding state when a booklet is drawn in and fed in a direction indicated by an arrow a. FIG. 2A and B illustrate members disposed on the upper position of the main portion, and the booklet printing device 1 is provided with a booklet inlet 40, an inlet standing portion 27, a flipping roller 17, a flipping roller motor 16 that is not illustrated, driving rollers 25a, 28a, 31a, driven rollers 25b, 28b, 31b, a fixed guide 26, and a movable guide 29.

**[0024]** The driving roller 25a, which is an insertion/ejection feeding roller pair, is disposed near the booklet inlet 40. The driven roller 25b, which is not illustrated, is placed under the driving roller 25a.

**[0025]** The driven roller 28b, which is an intermediate feeding roller pair, is disposed further inside of the driven roller 25b. The driving roller 28a, which is not illustrated, is disposed under the driven roller 28b. The flipping roller 17 is disposed coaxially with the shaft of the drive roller 28b.

**[0026]** Although the flipping roller 17 is disposed coaxially with the driven roller 28b, which is an intermediate feeding roller pair, it is driven by the dedicated flipping roller motor 16 illustrated in FIG. 1 and rotates independently from the driven roller 28b.

**[0027]** A driving roller 31a, which is an inner feeding roller pair, is disposed innermost. The driven roller 31b, which is not illustrated, is placed under the driving roller 31a.

**[0028]** FIG. 3 is a side view that schematically and comprehensively illustrates the structure of the main portion of the above-described page flipping mechanism. In addition to the arrow a indicating the booklet insertion direction, FIG. 3 illustrates a driving roller 25a, which is an insertion/ejection feeding roller pair, the driven roller 25b, the fixed guide 26, the driving roller 28a, which is an intermediate feeding roller pair, and the driven roller 28b.

**[0029]** Furthermore, FIG. 3 illustrates the flipping roller 17 disposed coaxially with the driven roller 28b, which is an intermediate feeding roller pair, the movable guide 29, the driving roller 31a, which is an inner feeding roller pair, the driven roller 31b, and the lifting member 24 integrated with a lifting roller 32 and disposed between the driving roller 28a, which is an intermediate feeding roller pair, and the driven roller 31b, which is an inner feeding roller pair, under a booklet feeding route formed by these three roller pairs.

**[0030]** FIG. 4A-FIG. 4G are operating state diagrams sequentially illustrating the operations of page flipping in the page flipping mechanism with the above structure. It should be noted that in FIG. 4A-FIG. 4G, the same numbers as those in FIG. 3 are assigned to the same portions as those in FIG. 3 that are needed for the explanation.

**[0031]** Moreover, in the following descriptions, the driving rollers and the driven rollers are not described, but, for example, the driving roller 25a and the driven roller 25b, which are insertion/ejection feeding roller pairs, are simply described as insertion/ejection feeding roller pairs 25a and 25b.

**[0032]** Firstly, FIG. 4A illustrates a state in which a booklet 33 carried in (drawn in) by the insertion/ejection feeding roller pairs 25a and 25b as indicated by the arrow a is fed so that preceding pages 33a of two facing pages of the booklet 33 are fed further inside of the inner feeding roller pairs 31a and 31b and the following pages 33b of the two facing pages are fed to a flipping position of the flipping roller 17.

**[0033]** Here, as illustrated in FIG. 4B, at the same time at which all three roller pairs stop, a gripper portion of the intermediate feeding roller pairs 28a and 28b opens and the movable guide 29 rotationally moves upwards to release the restriction above the feeding route.

**[0034]** Furthermore, the lifting member 24 is driven by the lifting roller 32 to rotationally move and lift the following pages 33b of the booklet 33 up to height h from the bottom. This lifting height h is a height that is lower than, or 60% high as, the conventional lifting height. The reason for this height is described in detail later.

**[0035]** Next, as illustrated in FIG. 4C, the flipping roller 17 rotates about 260 degrees in a counterclockwise direction indicated by an arrow b and is in sliding contact with an end edge of the top page 33b-1 of the following pages 33b of the booklet 33 so as to cause the top page 33b-1 to flexibly bend upward.

**[0036]** At that time the flipping roller motor 16 causes the flipping roller 17 to rotate at a speed that is lower than, or 40% the speed of, the rotational speed of the conventional flipping mechanism (hereinafter simply referred to as a conventional rotational speed) while causing cogging. The reason for this speed is described in detail later.

**[0037]** Next, as illustrated in FIG. 4D, the flipping roller 17 stops, and the lifting member 24 returns to its home position illustrated in FIG. 4A from the booklet lifting position. As a result, the following pages 33b of the booklet 33 return to the horizontal position, and the end edge of the top page 33b-1 lowered in response is pressed against the flipping roller 17 due to the repulsive force of the bend.

**[0038]** Next, as indicated by an arrow c in FIG. 4E, the flipping roller 17 rotates about 120 degrees in a counterclockwise direction from the above stop position, flips up the end edge of the top page 33b-1, and stops rotating. The end edge of the top page 33b-1 that is released from the bend by the flip-up flops over the stopped flipping roller 17.

**[0039]** Next, as illustrated in FIG. 4F, the intermediate feeding roller pairs 28a and 28b close the gripper portion and hold the booklet 33, and subsequently all feeding roller pairs, the insertion/ejection feeding roller pairs 25a and 25b, the intermediate feeding roller pairs 28a and 28b, and the inner feeding roller pairs 31a and 31b, rotate in a booklet ejection direction indicated by an arrow d.

**[0040]** As a result, while the booklet 33 is ejected, the

top page 33b-1 flopping over the stopped flipping roller 17 is, together with the ejection movement of the booklet 33, lifted by the driven roller 28b of the intermediate feeding roller pair, is pushed down, and overlays the preceding page 33a of the two facing pages.

**[0041]** Afterwards, as illustrated in FIG. 4G, the booklet 33 is subsequently ejected out of the flipping mechanism, the movable guide 29 returns to a regulatory guide position from the upper regulation release position, and the flipping roller 17 rotates about 20 degrees in a clockwise direction, indicated by an arrow e, from the flip-up stop position, and returns to its home position, where it was located before flipping started.

**[0042]** Here, the reason that the lifting member 24 illustrated in FIG. 4B lifts the following pages 33b of the booklet 33 up to a height that is lower than, or 60% high as, the conventional lifting height, and the reason that the flipping roller 17 illustrated in FIG. 4C rotates at a speed that is lower than, or 40% the speed of, the conventional rotational speed while causing cogging are explained.

**[0043]** Firstly, the inventor decided to examine the correlation between a success rate of flipping, an occurrence rate of a flipping of multiple pages at once of the successful flipping, the lifting height, and the rotation speed of the flipping.

**[0044]** It should be noted that because the success rate of flipping and the occurrence rate of a flipping of multiple pages at once are information correlating negatively with each other, the occurrence rate of a flipping of multiple pages at once is converted into and described as a prevention rate of a flipping of multiple pages at once (a success rate of normal flipping). As a result, all pieces of information indicate a success rate of flipping.

**[0045]** For this experiment, three types of booklets are prepared, including a booklet that has been used commonly (hereinafter simply referred to as a common booklet), a sample 1 booklet and a sample 2 booklet.

**[0046]** The common booklet is a booklet which is normally used (hereinafter also referred to as a passbook or medium). Sample 1 is a sample into which a dent has been made over plural pages so that stacked pages have become caught in one another and pages are not easily separated at the time of flipping. Sample 2 is a sample in which the friction coefficient between a subsequent page of a flipping target page and the next page is reduced so that the flipping of multiple pages at once easily occurs at the time of flipping the target page.

**[0047]** The relationship between the lifting height, a success rate of flipping, and a prevention rate of a flipping of multiple pages at once among the occurrences of successful flipping (a success rate of normal flipping) for the normal state medium and two types of samples modified so that a flipping of multiple pages at once easily occurs is studied in the above manner, and FIG. 5A-FIG. 5B describe the result of the study.

**[0048]** FIG. 5A is a table that lists data of actual measurements of the success rate of flipping and the prevention rate of flipping of multiple pages at once among the occurrences of successful flipping (a success rate of normal flipping) when the rotation speed of flipping is a normal speed and the lifting height is changed to various heights. In FIG. 5A, the current (normal) height is regarded as 100% height and the lifting heights are listed on the left column from 20% height to 160% height in increments of 20%. As an example, the normal height is 8.5 mm.

**[0049]** The next three columns of the lifting height column record the success rate of flipping for the normal medium, sample 1 and sample 2, and the three columns from the right record the prevention rate of flipping of multiple pages at once among the occurrences of successful flipping (a success rate of normal flipping).

**[0050]** FIG. 5B is a graph of the data of the three columns next to the lifting height column in the table of FIG. 5A, and the normal medium is indicated by M-S1, sample 1 is indicated by S1-S1, and sample 2 is indicated by S2-S2. The height from 20% to 160% is on the horizontal axis and the success rate of flipping from 0-100% is on the vertical axis. It should be noted that any page flipping regardless of the presence/absence of a flipping of multiple pages at once is regarded as successful flipping.

**[0051]** FIG. 5C is a graph of the data of the right three columns in the table of FIG. 5A, and in this graph also, the normal medium is indicated by M-S2, sample 1 is indicated by S1-S2, and sample 2 is indicated by S2-S2. The height from 20% to 160% is on the horizontal axis and the success rate of flipping from 0 to 100% is on the vertical axis.

**[0052]** FIG. 6A is a graph combining the two graphs in FIG. 5B and FIG. 5C into one, and FIG. 6B is a graph of when the two pieces of graph data in FIG. 5B and FIG. 5C are synthesized (integrated), representing a comprehensive success rate of flipping when the two measurements are performed. From the three types of data in FIG. 6B, it can be interpreted that the success rate of flipping is high in a range of 60% height - 100% height.

**[0053]** In FIG. 5A, FIG. 5B, and FIG. 5C, regarding the prevention rate of flipping of multiple pages at once, the prevention rate of flipping of multiple pages at once (a success rate of normal flipping) is 100% when the height is 100% or lower in the normal medium. However, when the result of sample 2 is observed, up to the height 60%, the prevention rate of flipping of multiple pages at once is high, but the prevention rate of flipping of multiple pages at once (a success rate of normal flipping) declines drastically at a height higher than 60%.

**[0054]** However, when the height becomes 100% and higher, the success rate of flipping reduces. Even so, the normal medium maintains the success rate of flipping of 70%, which is a relatively high value, at the 60% height, and therefore the basic height is made to be 60% height-100% height (5mm-8.5mm) in order to maintain a high prevention rate of flipping of multiple pages at once while dealing with changes in paper quality.

**[0055]** Next, the relationship between the rotation

speed of the flipping roller motor 16 that drives the flipping roller 17 to rotate, a success rate of flipping, and a prevention rate of a flipping of multiple pages at once among the occurrences of successful flipping (a success rate of normal flipping) for the normal state medium and two types of samples modified so that a flipping of multiple pages at once easily occurs is studied, and FIG. 7A-FIG. 8B describe the result of the study.

**[0056]** FIG. 7A is a table that lists data of actual measurements of the success rate of flipping and the prevention rate of flipping of multiple pages at once among the occurrences of successful flipping (a success rate of normal flipping) when the lifting height is the conventional height and the motor rotation speed is changed to various speeds.

**[0057]** In FIG. 7A, the normal speed of the motor rotation is regarded as 100%, and the speeds are listed on the left column from 20% speed to 160% speed in increments of 20%. As an example, the normal speed is 16 rad/sec.

**[0058]** The next three columns of the motor rotation speed column record the success rate of flipping for the normal medium, sample 1 and sample 2, and the three columns from the right record the prevention rate of flipping of multiple pages at once among the occurrences of successful flipping (a success rate of normal flipping).

**[0059]** FIG. 7B is a graph of the data of the three columns next to the motor rotation speed column in the table of FIG. 7A, and the normal medium is indicated by M-S1, sample 1 is indicated by S1-S1, and sample 2 is indicated by S2-S1.

**[0060]** The motor rotation rate from 20% to 160% is on the horizontal axis and the success rate of flipping from 0-100% is on the vertical axis. It should be noted that in this case also, any page flipping, regardless of the presence/absence of flipping of multiple pages at once, is regarded as successful flipping.

**[0061]** FIG. 7C is a graph of the data of the right three columns in the table of FIG. 7A, and in this graph also, the normal medium is indicated by M-S2, sample 1 is indicated by S1-S2, and sample 2 is indicated by S2-S2.

**[0062]** The motor rotation speed from 20% to 160% is on the horizontal axis and the prevention rate of flipping of multiple pages at once among the occurrences of successful flipping (a success rate of normal flipping) from 0 to 100% is on the vertical axis.

**[0063]** FIG. 8A is a graph combining the two graphs in FIG. 7B and FIG. 7C into one, and FIG. 8B is a graph of when the two pieces of graph data in FIG. 7B and FIG. 7C are synthesized (integrated), representing a comprehensive success rate of flipping when the two measurements are performed.

**[0064]** From the three types of data in FIG. 8B, it can be interpreted that the success rate of flipping is high, in a range of 20% speed-60% speed.

**[0065]** In FIG. 7A, FIG. 7B, and FIG. 7C, regarding the prevention rate of flipping of multiple pages at once (a success rate of normal flipping), the prevention rate is 100% when the motor rotation rate is 100% or lower in the normal medium. However, when the results of sample 1 and sample 2 are observed, the occurrence rate of flipping of multiple pages at once declines drastically at a motor rotation rate lower than 60%.

**[0066]** Here, independently from the occurrence rate of flipping of multiple pages at once, a 100% success rate of flipping is maintained regardless of the difference between the normal medium, sample 1, and sample 2 when the motor rotation rate is 120% or lower. However, the basic motor rotation rate is made to be 20%-60% (3.2 rad/sec-9.6 rad/sec) in order to maintain a high prevention rate of flipping of multiple pages at once (a success rate of normal flipping) while dealing with changes in paper quality.

**[0067]** Although cogging depends on the motor characteristics, in the motor in the present embodiment, cogging occurs at 60% of the normal rotation frequency (here, 9.6 rad/sec). The vibrations to the flipping roller caused by the cogging at the time of flipping contribute to the function of separating only the top page and flipping the page.

**[0068]** In addition, a method for performing flipping by combining a 60% lifting height and a 40% motor rotation rate on the basis of the above somewhat sacrifices the success rate of flipping in favor of a reduction in the occurrence rate of flipping of multiple pages at once so as to be able to deal with changes in paper quality. As a result, the success rate of flipping is low for the normal medium. In this case, improvement can be made by changing the lifting height at the retry stage.

**[0069]** It should be noted that in the above-described embodiments, various modifications can be added within the scope of the embodiments.

## Claims

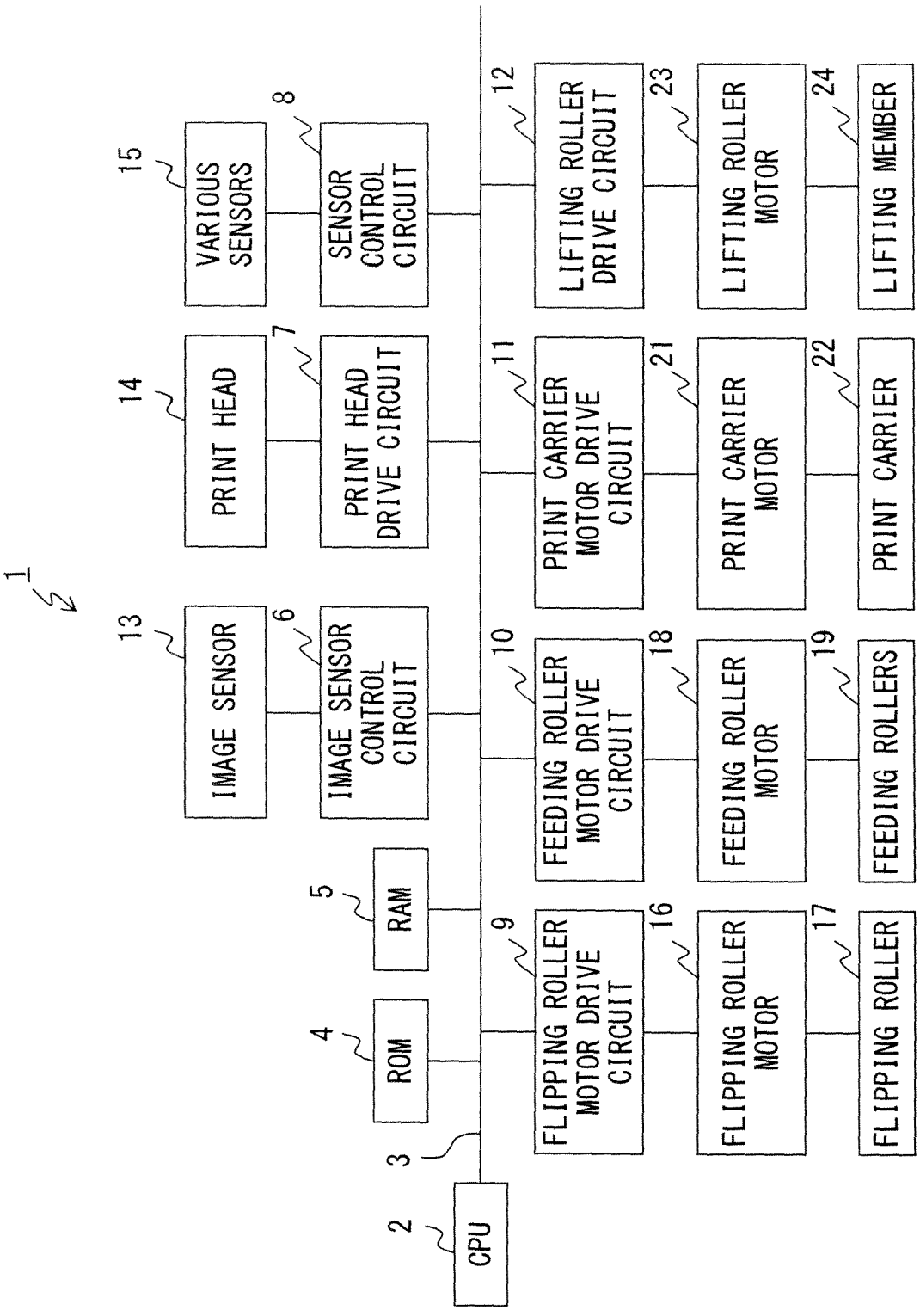
**1.** A booklet printing apparatus provided with a page flipping mechanism, wherein
the page flipping mechanism includes at least an insertion/ejection feeding roller, an intermediate feeding roller, an inner feeding roller, a page flipping roller arranged coaxially with the intermediate feeding roller and rotated by a dedicated motor independently from the intermediate feeding roller, and a lifting member arranged below a surface of a feeding route between the intermediate feeding roller and the inner feeding roller, and
wherein
the insertion/ejection feeding roller causes a booklet to be inserted with a first line of a printing field on facing pages first,
the intermediate feeding roller takes up a feed of the inserted booklet,
the inner feeding roller takes over feeding of the booklet and pulls the booklet inside,
the lifting member lifts a portion in which a page to

be flipped of the facing pages of the booklet is present up to a height of 60% to 100% of a normal lifting height from a bottom,
the dedicated motor rotates at a low speed to rotate the page flipping roller at a speed of 60% of a normal rotation and generates cogging, and
the page flipping roller flips the page to be flipped by a rotation of 20% to 60% of the normal rotation while propagating vibration of cogging of the dedicated motor to the page to be flipped.

**2.** The booklet printing apparatus of claim 1, wherein the height of 60% to 100% of the normal lifting height is 5 mm to 8.5 mm.

**3.** The booklet printing apparatus of claim 1 or 2, wherein
the rotation of 20% to 60% of the normal rotation of the page flipping roller to flip the page to be flipped is 3. 2 rad/sec to 9.6 rad/sec.

**4.** The booklet printing apparatus of any of claims 1 to 3, wherein the dedicated motor rotates the page flipping roller at 9.6 rad/sec or less.


1
2
CPU
3
4
ROM
5
RAM
6
IMAGE SENSOR CONTROL CIRCUIT
7
PRINT HEAD DRIVE CIRCUIT
8
SENSOR CONTROL CIRCUIT
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FLIPPING ROLLER MOTOR DRIVE CIRCUIT
10
FEEDING ROLLER MOTOR DRIVE CIRCUIT
11
PRINT CARRIER MOTOR DRIVE CIRCUIT
12
LIFTING ROLLER DRIVE CIRCUIT
13
IMAGE SENSOR
14
PRINT HEAD
15
VARIOUS SENSORS
16
FLIPPING ROLLER MOTOR
17
FLIPPING ROLLER
18
FEEDING ROLLER MOTOR
19
FEEDING ROLLERS
21
PRINT CARRIER MOTOR
22
PRINT CARRIER
23
LIFTING ROLLER MOTOR
24
LIFTING MEMBER

FIG. 1

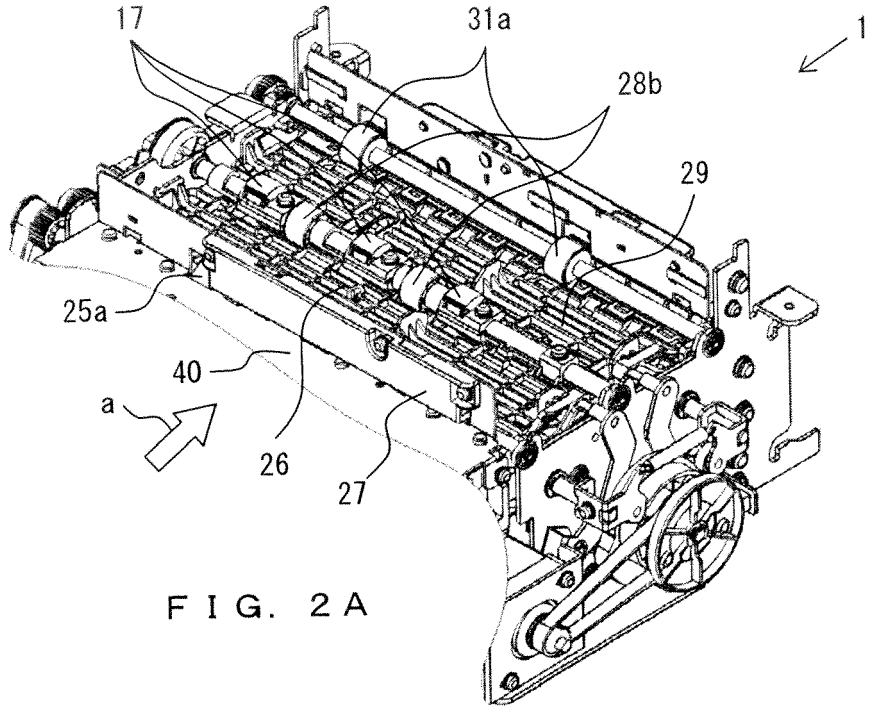


FIG. 2A

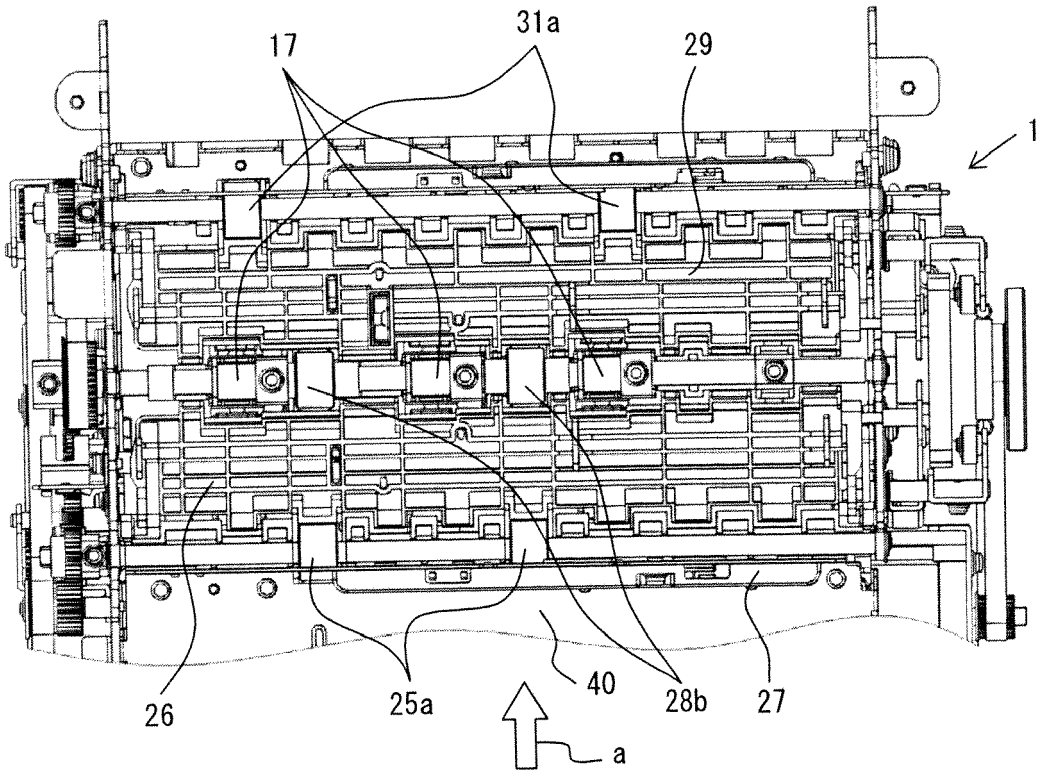


FIG. 2B

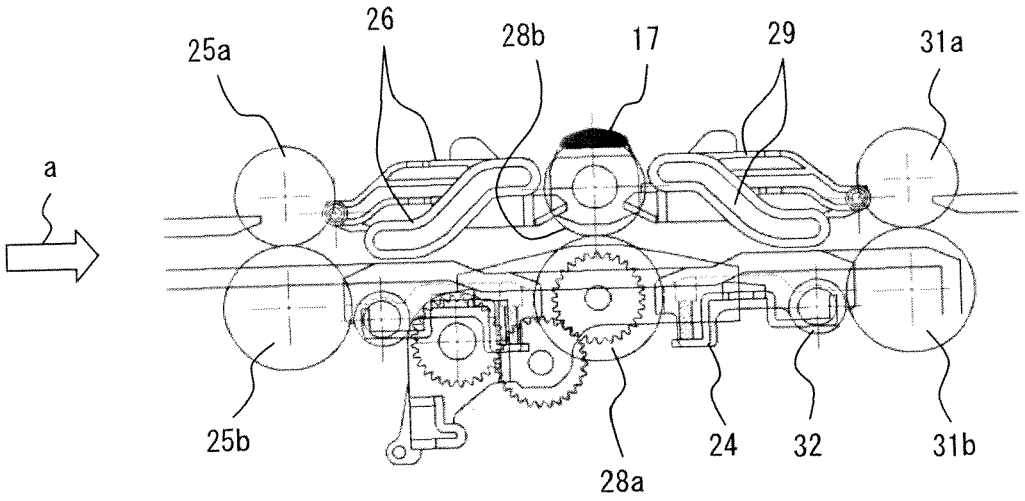


FIG. 3

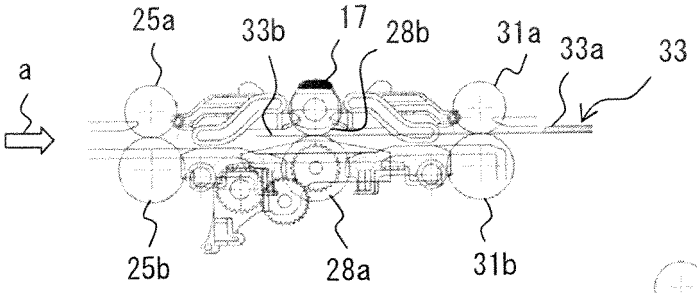


FIG. 4A

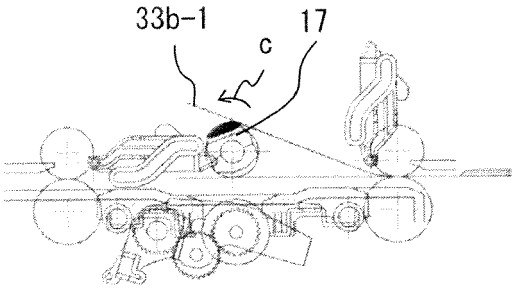


FIG. 4E

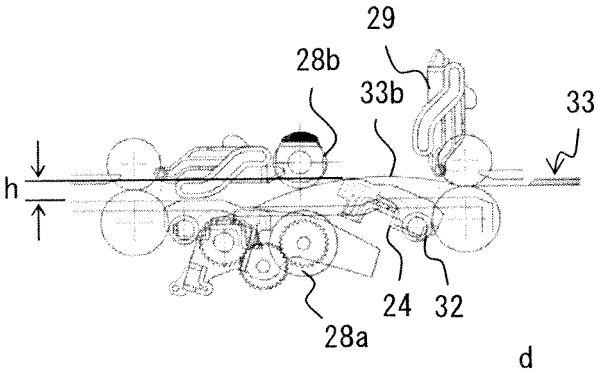


FIG. 4B

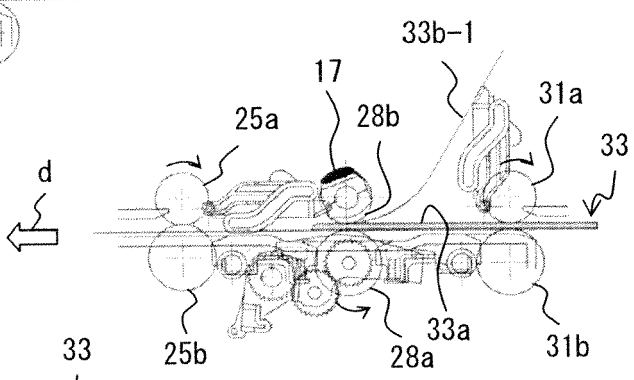


FIG. 4F

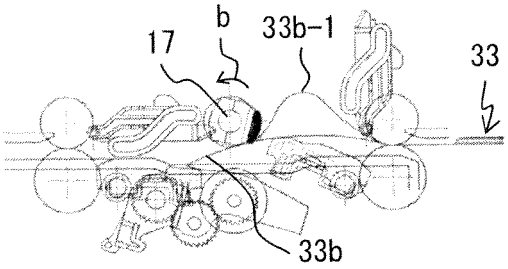


FIG. 4C

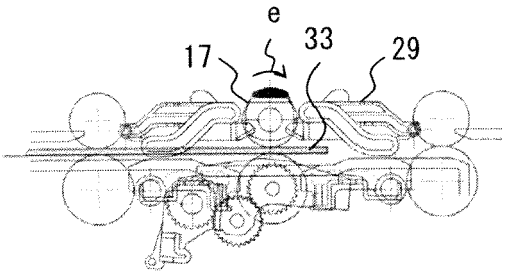


FIG. 4G

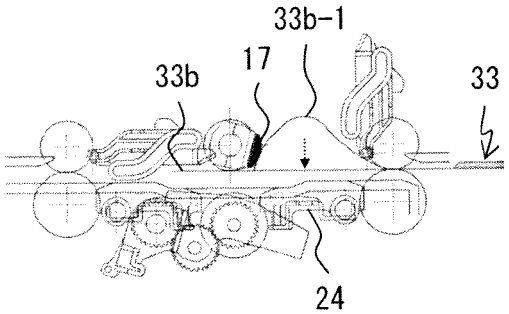


FIG. 4D

| LIFTING HEIGHT | SUCCESS RATE OF FLIPPING NORMAL MEDIUM | SUCCESS RATE OF FLIPPING SAMPLE 1 | SUCCESS RATE OF FLIPPING SAMPLE 2 | PREVENTION RATE OF FLIPPING MULTIPLE PAGES OF NORMAL MEDIUM (AMONG SUCCESSFUL FLIPPING) | PREVENTION RATE OF FLIPPING MULTIPLE PAGES OF SAMPLE 1 (AMONG SUCCESSFUL FLIPPING) | PREVENTION RATE OF FLIPPING MULTIPLE PAGES OF SAMPLE 2 (AMONG SUCCESSFUL FLIPPING) |
|---|---|---|---|---|---|---|
| 20% HEIGHT | 0 | 0 | 0 | 100 | 95 | 95 |
| 40% HEIGHT | 45 | 25 | 50 | 100 | 90 | 90 |
| 60% HEIGHT | 70 | 65 | 60 | 100 | 85 | 85 |
| 80% HEIGHT | 95 | 90 | 85 | 100 | 80 | 65 |
| CURRENT (100% HEIGHT) | 100 | 100 | 100 | 100 | 65 | 45 |
| 120% HEIGHT | 100 | 100 | 100 | 80 | 45 | 35 |
| 140% HEIGHT | 100 | 100 | 100 | 60 | 25 | 15 |
| 160% HEIGHT | 100 | 100 | 100 | 30 | 0 | 0 |

FIG. 5A

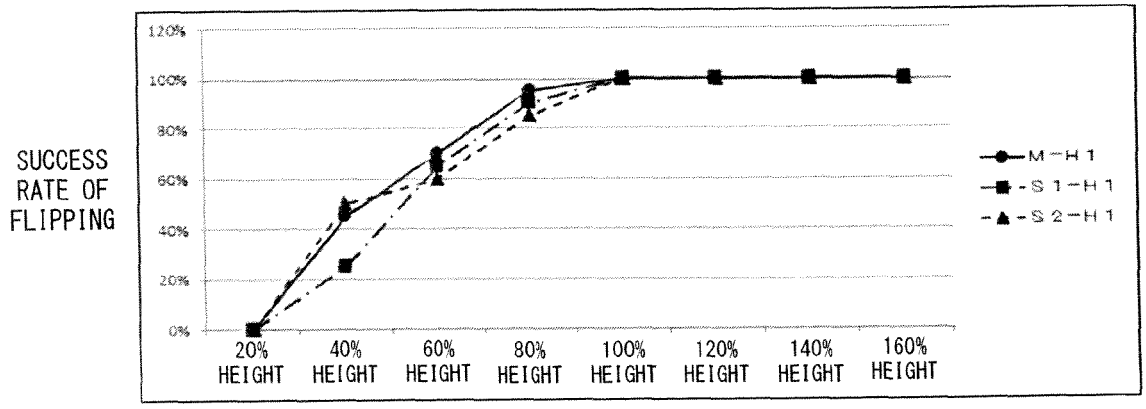


FIG. 5B

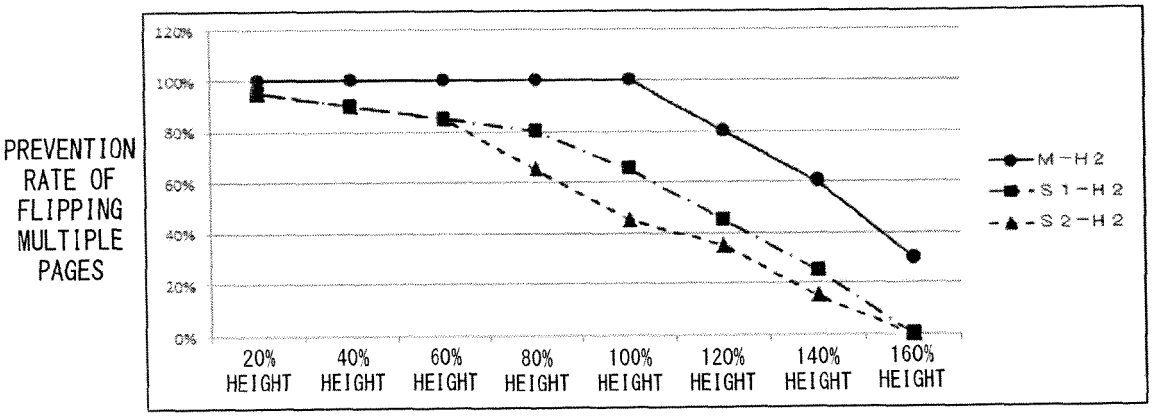


FIG. 5C

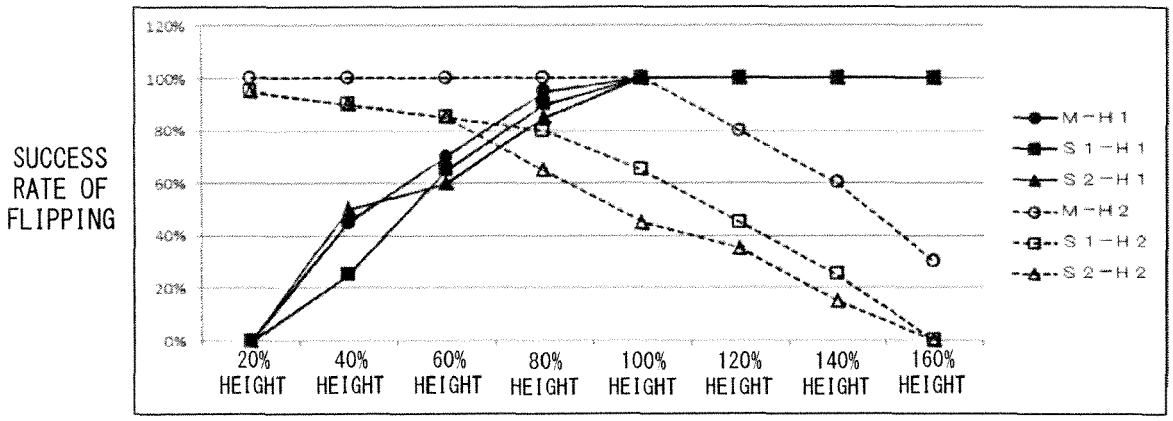
SUCCESS RATE OF FLIPPING
120%
100%
80%
60%
40%
20%
0%
20% HEIGHT
40% HEIGHT
60% HEIGHT
80% HEIGHT
100% HEIGHT
120% HEIGHT
140% HEIGHT
160% HEIGHT
M-H1
S1-H1
S2-H1
M-H2
S1-H2
S2-H2

FIG. 6A

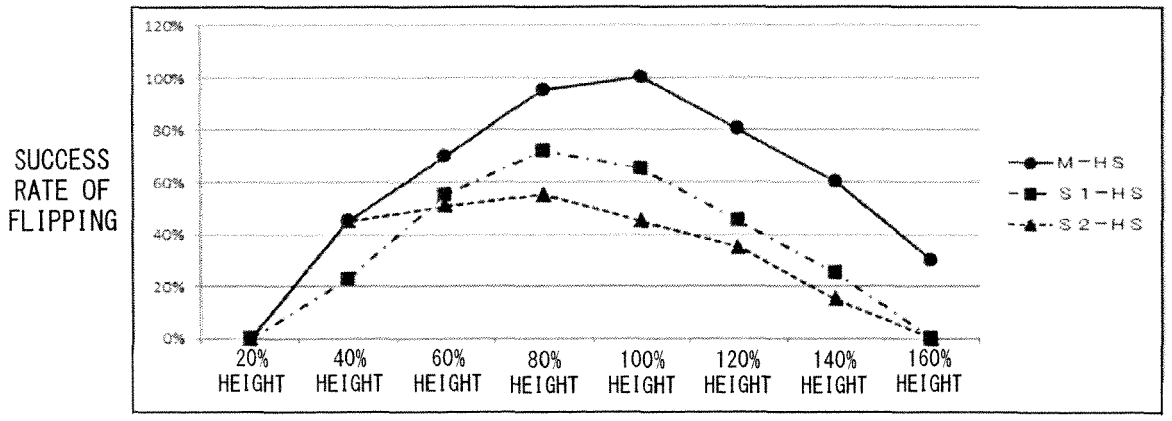
SUCCESS RATE OF FLIPPING
120%
100%
80%
60%
40%
20%
0%
20% HEIGHT
40% HEIGHT
60% HEIGHT
80% HEIGHT
100% HEIGHT
120% HEIGHT
140% HEIGHT
160% HEIGHT
M-HS
S1-HS
S2-HS

FIG. 6B

| MOTOR ROTATION SPEED | SUCCESS RATE OF FLIPPING NORMAL MEDIUM | SUCCESS RATE OF FLIPPING SAMPLE 1 | SUCCESS RATE OF FLIPPING SAMPLE 2 | PREVENTION RATE OF FLIPPING MULTIPLE PAGES OF NORMAL MEDIUM (AMONG SUCCESSFUL FLIPPING) | PREVENTION RATE OF FLIPPING MULTIPLE PAGES OF SAMPLE 1 (AMONG SUCCESSFUL FLIPPING) | PREVENTION RATE OF FLIPPING MULTIPLE PAGES OF SAMPLE 2 (AMONG SUCCESSFUL FLIPPING) |
|---|---|---|---|---|---|---|
| 20% SPEED | 100 | 100 | 100 | 100 | 95 | 90 |
| 40% SPEED | 100 | 100 | 100 | 100 | 90 | 85 |
| 60% SPEED | 100 | 100 | 100 | 100 | 75 | 70 |
| 80% SPEED | 100 | 100 | 100 | 100 | 30 | 25 |
| CURRENT (100% SPEED) | 100 | 100 | 100 | 100 | 20 | 15 |
| 120% SPEED | 100 | 100 | 100 | 80 | 15 | 15 |
| 140% SPEED | 100 | 85 | 100 | 75 | 15 | 10 |
| 160% SPEED | 100 | 70 | 80 | 65 | 10 | 10 |

FIG. 7A

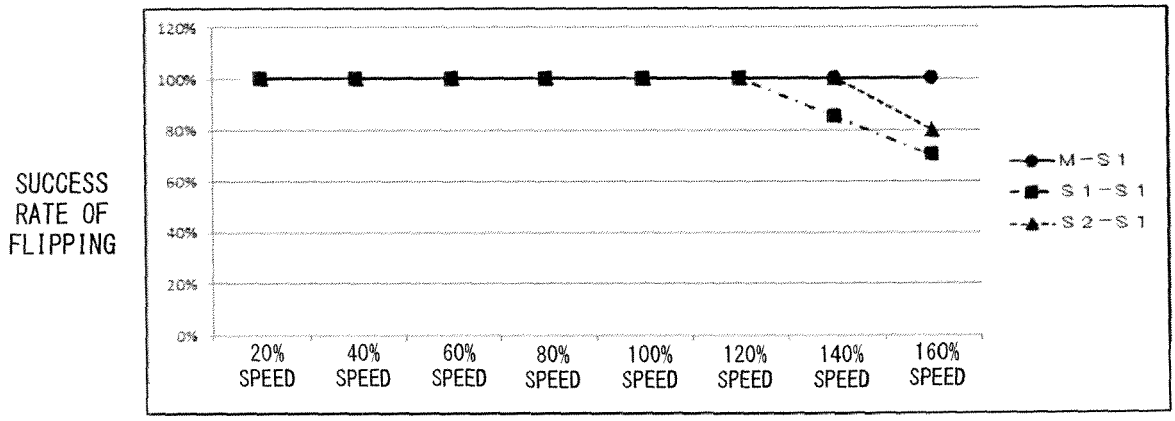


FIG. 7B

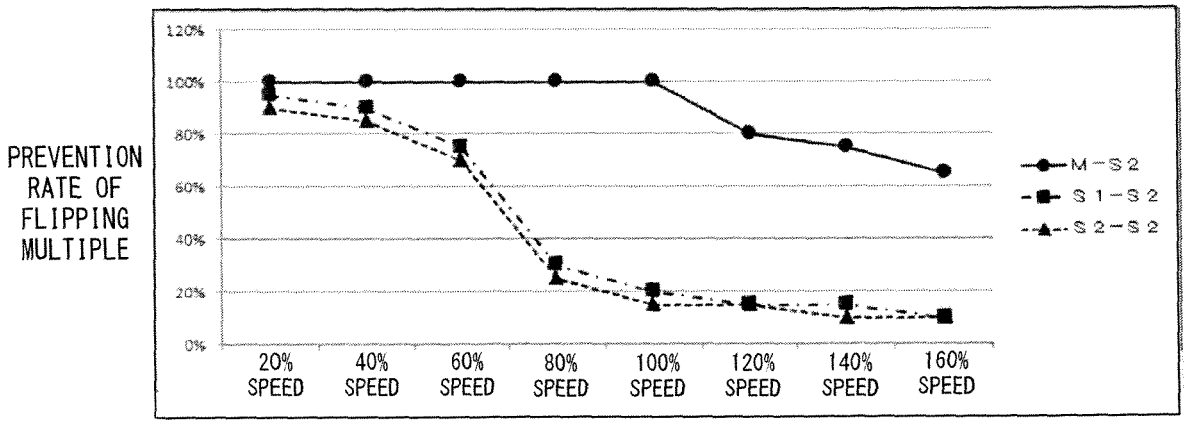


FIG. 7C

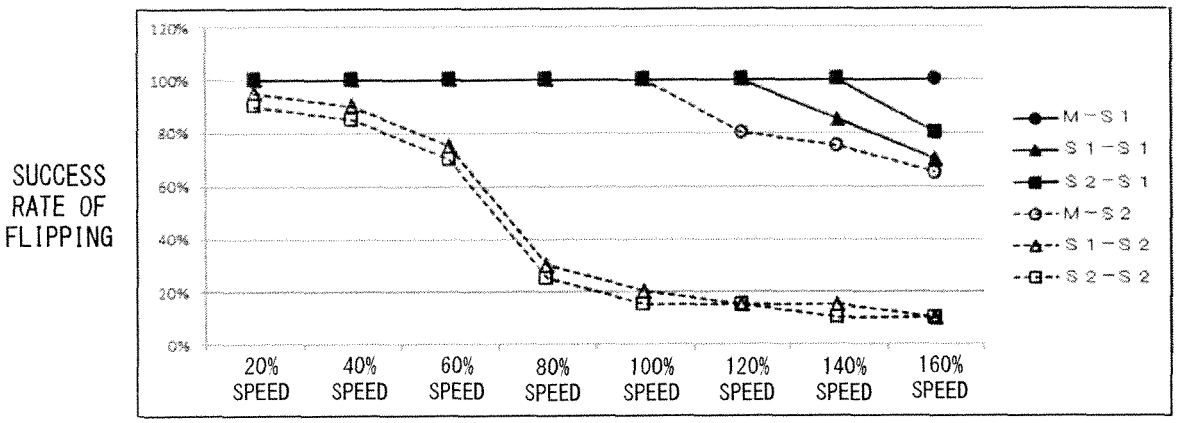
SUCCESS RATE OF FLIPPING
120%
100%
80%
60%
40%
20%
0%
20% SPEED
40% SPEED
60% SPEED
80% SPEED
100% SPEED
120% SPEED
140% SPEED
160% SPEED
M－S１
S１－S１
S２－S１
M－S２
S１－S２
S２－S２

FIG. 8A

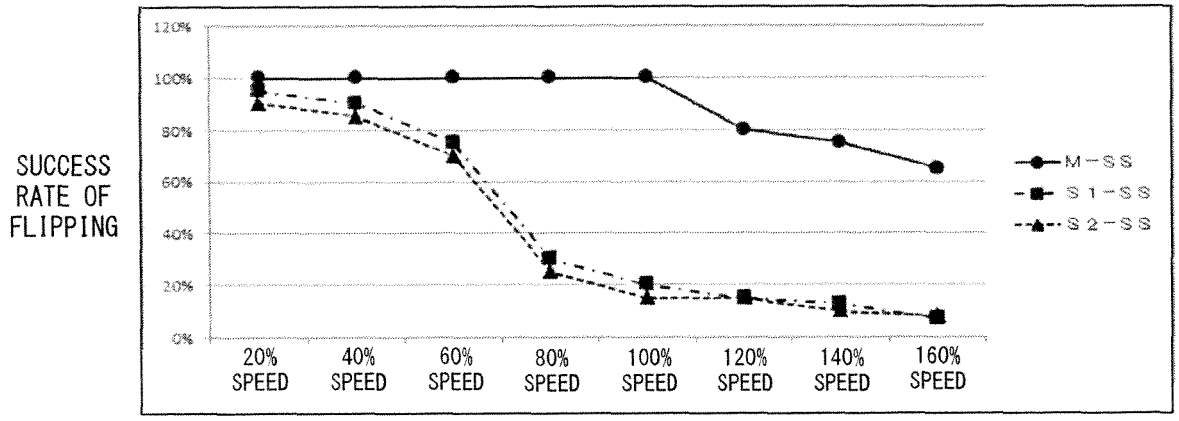
SUCCESS RATE OF FLIPPING
120%
100%
80%
60%
40%
20%
0%
20% SPEED
40% SPEED
60% SPEED
80% SPEED
100% SPEED
120% SPEED
140% SPEED
160% SPEED
M－SS
S１－SS
S２－SS

FIG. 8B

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# EUROPEAN SEARCH REPORT

Application Number
EP 14 17 9165

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
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|---|---|---|
| Munich | 30 January 2015 | Seiler, Reinhold |

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